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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLN. OF: ITO
PATENT NO: 6,809,039 **B2**
ISSUED: October 26, 2004
FOR: Method for Forming A Silicide Layer
GROUP: 1765
EXAMINER: Vinh, Lan
DOCKET: NEC 2360

Certificate
DEC 14 2004
of Correction

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

PETITION FOR CERTIFICATE OF CORRECTION

Dear Sirs:

Ito, the Patentee of the above-identified patent, through his attorney, hereby petitions for issuance of a Certificate of Correction in the above identified patent. A Certificate of Correction (PTO form 1050) is enclosed, in duplicate. The Certificate of Correction is required to correct significant printing errors occurring in Claim 1 and Figure 5, as follows:

Claim 1, Column 4, Lines 39-40, delete the word "nietalsilieide".

Figure 5, Box S2, "treting" should be --treating--.

Since the error was a Patent Office error, it is believed that the Certificate of Correction should be issued without charge to the Applicant. A correct copy of Claim 1 appears in Amendment C (copy attached). Also attached is a correct copy of Figure 5 as submitted with the Issue Fee.

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Respectfully submitted,



Norman P. Soloway
Attorney for Applicant
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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on November 30, 2004 at Tucson, Arizona

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO : 6,809,039 *B2*

DATED : October 26, 2004

INVENTOR(S) : ITO

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Claim 1, Column 4, Lines 39-40, delete the word "nietalsilieide".
Figure 5, Box S2, "treting" should be --treating--.

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PATENT NO. 6,809,039

No. of additional copies



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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO : 6,809,039 **B2**

DATED : October 26, 2004

INVENTOR(S) : ITO

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Claim 1, Column 4, Lines 39-40, delete the word "nietalsilieide".
Figure 5, Box S2, "treting" should be --treating--.

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COPY

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Appln. Of: ITO
Serial No.: 09/940,247
Filed: August 27, 2001
For: METHOD FOR FORMING A SILICIDE LAYER
Group: 1765
Examiner: Lan Vinh DOCKET: NEC 2360

MAIL STOP NON-FEE AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT C

Dear Sir:

This Amendment is being filed in response to the Official Action mailed December 24, 2003.

Please amend the Application as follows:

Amendments to the Claims begin on page 2 of this Amendment.

Remarks/Arguments begin on page 4 of this Amendment.

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AMENDMENTS TO THE CLAIMS:

Kindly amend claim 1, as shown below.

This listing of claims will replace all prior versions and listings of claims in the Application:

Claim 1 (currently amended): A method for forming a metal silicide layer in a self-aligned manner on a source region, a drain region and a gate electrode of a semiconductor device formed on a semiconductor substrate, said method comprising the steps of:

- (A) depositing a cobalt film over an entire surface of said semiconductor device formed on said semiconductor substrate,
- (B) forming a silicidized cobalt film layer on said source region, drain region and said gate electrode by performing a heat treating thereof, and
- (C) etching away an unreacted cobalt film remaining on said semiconductor substrate while leaving the ~~metal silicide~~ silicidized cobalt film layer intact, using as an etching solution an admixture solution consisting essentially of hydrochloric acid, hydrogen peroxide, and water, having relative concentration ratio thereof ranging from 1:1:5 to 3:1:5, at a solution temperature of 25 to 45°C, with an etching time of 1 to 20 minutes.

Claim 2 (previously presented): The method as claimed in claim 1, wherein said silicidized cobalt film layer comprises a silicidized cobalt selected from the group consisting of dicobalt silicide, cobalt monosilicide and cobalt disilicide.

Claim 3 (previously presented): The method according to claim 1, wherein said heat treating of step (B) is conducted at a temperature of 500°C or higher.

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Claim 4 (previously presented): The method as claimed in claim 3, and further comprising a Step (D) of heat treating the product resulting from Step (C) at a temperature higher than a temperature of heat treating in Step (B).

Claim 5 (previously presented): The method as claimed in claim 4, wherein said heat treating of Step (D) is conducted at a temperature of 800°C.

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REMARKS

Claim 1 has been amended to employ consistent language through the claim. No new matter has been added by this change.

The Examiner's rejection of claims 1-5 under 35 USC § 103(a) as being obvious over Jeng et al. (US Patent 6,251,177), newly cited, in view of Bulat et al. (US Patent 4,713,358), newly cited, is improper. It is submitted that the Examiner has employed impermissible hindsight, and has applied the teachings of the present invention to the prior art to make out a case of obviousness.

Applicant's invention is the discovery of the criticality of the combination of claimed ranges for the concentration and temperature of the etching solution, and the etching time. Applicant's sworn specification explains that Applicant found "the occurrence of failures [bad silicide formation] was found to be highly dependant on the concentration and temperature of the etching solution, and the etching time." Amendment to Specification, Amendment A, pg. 3. The Examiner's rejection, however, ignores the criticality of the combination, and picks and chooses individual elements from Jeng et al. and Bulat et al. to recreate the Applicant's invention. The primary reference Jeng et al. teaches a maximum relative concentration of 37% hydrochloric acid:30% hydrogen peroxide:water of 1:1:5. Applicant's claimed invention requires a minimum relative concentration of hydrochloric acid:hydrogen peroxide:water of 1:1:5. Moreover, Jeng et al., as the Examiner admits, does not teach using a solution temperature in the ranges of 25 to 50°C. Rather, Jeng et al. teaches using higher temperature for the etching solution. Therefore, the Examiner cites Bulat et al. as teaching the use of a solution temperature of 25°C. However, Bulat et al. does not teach the claimed ranges for the concentration of etching solution or the

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etching time. Indeed, Bulat et al. fails to teach any concentration. The criticality of the combination of the claimed solution temperature and concentration ranges is not taught in either reference. Thus, the Examiner is using hindsight to combine the references and formulate the rejection.

Moreover, there are other distinctions.

The primary reference Jeng et al. forms metal silicide in a single step by exposing a silicon layer which has been heated up to a silicidation temperature with metal flux. On the other hand, the present invention includes a first step of forming a metal (cobalt) on a silicon layer and a second step of silicidizing the metal and the silicon layer.

Since Jeng et al. has as an object to simplify the process (see column 2, lines 64 to 67 of Jeng et al.), Jeng et al. does not give any motivation to a person skilled in this art to divide the single step of forming the metal silicide as above discussed into two steps, i.e., a first step of forming a metal and a second step of silicidizing the metal as required by the present invention.

Further, it is submitted that one skilled in the art would not be motivated to combine Jeng et al. and Bulat et al. as suggested by the Examiner. Jeng et al. teaches forming a metal silicide by exposing a silicon layer which has been heated up to a silicidation temperature with metal flux and then the metal which has attached to portions except for the silicon layer, is removed with an etchant having a predetermined composition.

On the other hand, Bulat et al. teaches a two step method in which after a metal has been formed on a silicon layer, the metal and the silicon layer are both silicidized and then unreacted metal is removed with etchant with a predetermined etchant temperature.

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Further, the method of silicidation as taught in Jeng et al. is completely different from that of Bulat et al.

It must be remembered Jeng et al. has as an object to simplify the silicidation process, and to this end teaches a one step process. Bulat et al., on the other hand teaches a complicated multi-step process.

Having dealt with all the objections raised by the Examiner, the Application is believed to be in order for allowance. Early and favorable action are respectfully requested.

In the event there are any fee deficiencies or additional fees are payable, please charge them (or credit any overpayment) to our Deposit Account Number 08-1391.

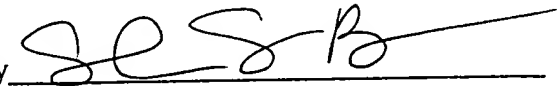
Respectfully submitted,



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COPY

5/5

Fig. 5

